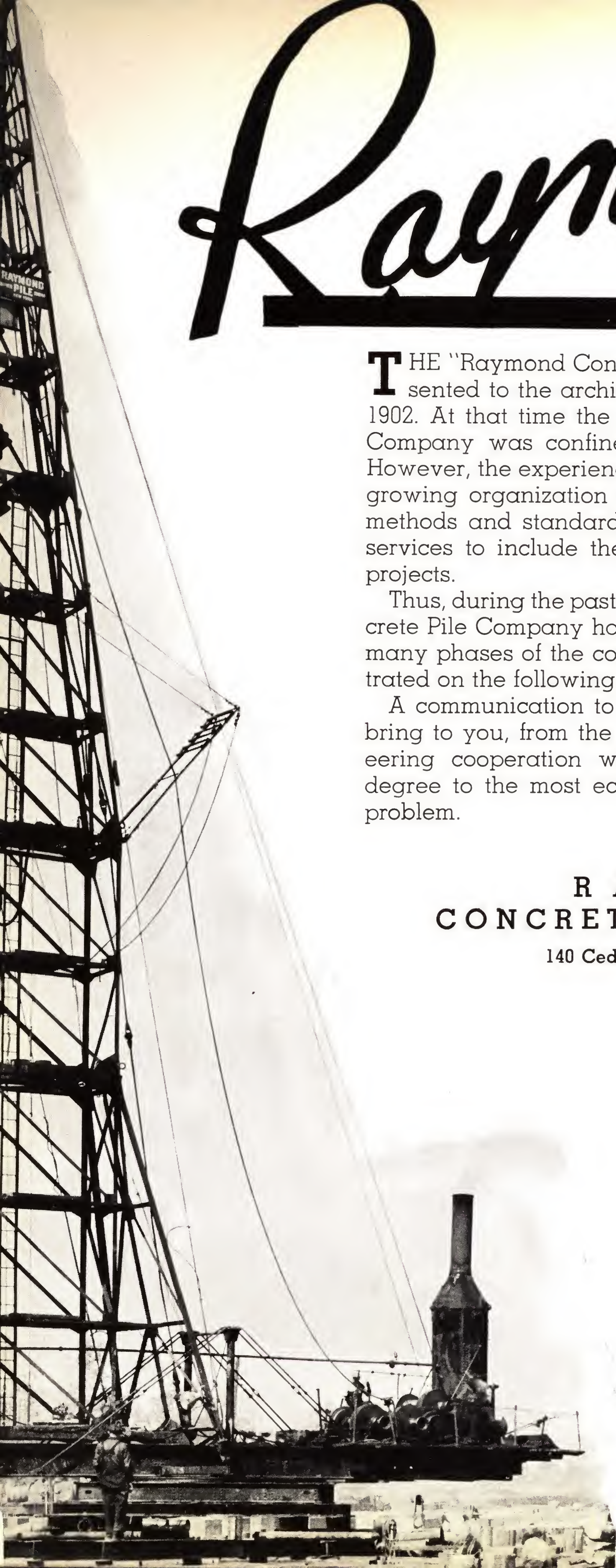

# RAYMOND
## CONCRETE PILES




# Raymond

THE "Raymond Concrete Pile" was developed and first presented to the architectural and engineering professions in 1902. At that time the activity of the Raymond Concrete Pile Company was confined exclusively to that foundation unit. However, the experience and facilities acquired by the rapidly growing organization and the nation-wide acceptance of its methods and standards naturally broadened its engineering services to include the design and construction of complete projects.

Thus, during the past quarter of a century, the Raymond Concrete Pile Company has established an enviable record in the many phases of the construction industry described and illustrated on the following pages.

A communication to any of the addresses listed below will bring to you, from the preliminary stages of a project, engineering cooperation which will contribute in an important degree to the most economical solution of your construction problem.

## RAYMOND CONCRETE PILE COMPANY

**140 Cedar Street, NEW YORK, N. Y.**

ATLANTA, GA. ........ 49 Forsyth St.
BALTIMORE, MD. ........ S. E. cor. Fayette & Calvert Sts.
BOSTON, MASS. ........ 31 St. James Ave.
CHICAGO, ILL. ........ 111 W. Monroe St.
CLEVELAND, OHIO ........ 1740 E. 12th St.
DETROIT, MICH. ........ 417 New Center Bldg.
LOS ANGELES, CALIF. ........ 311 So. Spring St.
PHILADELPHIA, PA. ........ 1520 Locust St.
PITTSBURGH, PA. ........ Cor. 4th Ave. & Wood St.
SAN FRANCISCO, CALIF. ........ 333 Montgomery St.
WASHINGTON, D. C. ........ 732—15th St., N.W.
A. C. EVERHAM ........ KANSAS CITY, MO., 114 W. 10th St.
W. J. MULHALL ........ MIAMI, FLA., 365 N. E. 55th St.
J. D. McCORD ........ MILWAUKEE, WIS., 7106 W. North Ave.
R. S. DORNBERGER ........ PORTLAND, ORE., 6323 E. 31st St.
JAS. TAUSSIG, Jr. ........ ST. LOUIS, MO., 214 No. 6th St.
G. W. OAKES ........ ST. PAUL, MINN., 162-60 E. 6th St.
J. L. WICK ........ SEATTLE, WASH., 1725 W. Lake North
RAYMOND CONCRETE PILE CO., LTD.
MONTREAL, CAN., 620 Cathcart St.
RAYMOND CONCRETE PILE CO., LTD.
TORONTO, CAN., 170 Bay St.
CIMENTACIONES Y CONSTRUCCIONES, S.A.
MEXICO CITY, D.F., Avenida 16 de Septiembre Num 5
RAYMOND CONCRETE PILE COMPANY
BOGOTA, COLOMBIA
RAYMOND CONCRETE PILE COMPANY
BARRANQUILLA, COLOMBIA
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CARACAS, VENEZUELA
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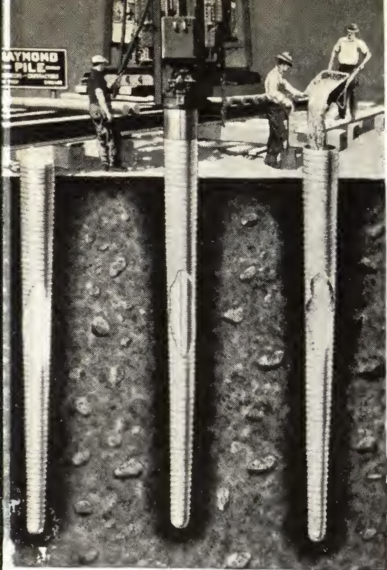
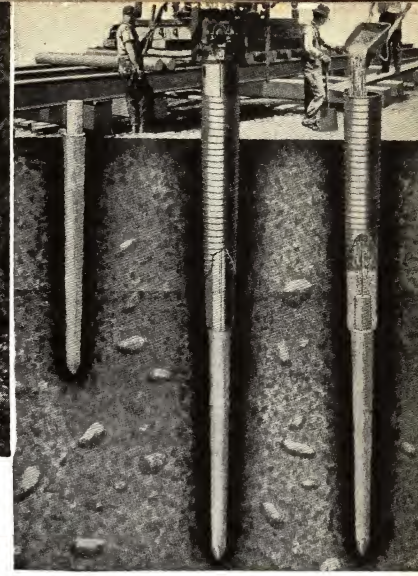
MARACAIBO, VENEZUELA



Raymond Tapered Concrete Piles: 1. Unfilled Shell ready for Inspection —2. Completely driven—3. Pouring Concrete.

A group of Standard Raymond Tapered Concrete Piles ready for the concrete footing to be poured.



Raymond Composite Piles: 1. Driven Wood Section—2. Driving completed —3. Pouring Concrete.

# INDEX
## *of*
## *Raymond Services*




Rotary Drilling for Wet Process Type Caisson (Note water connection to drill stem).

Gow Caissons, ready for foundation beams—Caissons are belled out in rock approximately 40 feet below surface and built up 20 feet to grade.

Installing Gow Caisson Piles.


Gow Caisson Pile, ready for Inspection and Concrete.

Below: A fleet of eight Raymond Steel Drivers on a job consisting of more than 18,000 Raymond Concrete Piles.

Below: A supply of heavy gauge 24 foot pipe sections of Raymond Step Tapered Composite Piles.

OFFICE BUILDING, Houston, Texas
John Eberson, Architect
Supported on
1346 RAYMOND CONCRETE PILES

## A BUILDING IS AS GOOD AS ITS FOUNDATION

However well a building may be constructed, it must have a proper foundation. Usually it is inadvisable to design a building before tests of the ground at the site are made. Soil tests disclose conditions below the surface of the ground, and if deficiencies in bearing values exist, they may be taken into consideration when designing the structure and fixing its location.

Where ample land is available, it has been found advantageous on many occasions to re-locate the building. Rock ledges, out-croppings, springs, quick-sand, fill, soft deposits, etc., are frequently avoided by changes of locations on the same site.



# Their Importance to the Architect and Engineer

It is common knowledge that the successful erection and length of service of any building depends to an important degree upon the stability of the foundation. Where the foundation goes to an appreciable depth, or the building is large and of permanent character, information regarding the stratum or material upon which the foundation will rest is essential. In the case of piles, driven through various strata, it is necessary to know how the resistance developed by the driving will react in each stratum. Accurate calculations for foundations, with or without piles, can only be made when driving and load tests have been made and analyzed **by experts of long experience.**

A brief summary of the services of this type conducted by our Engineering Staff follows.

## FOUNDATIONS FOR ENGINEERING PROJECTS

It is important to have accurate soil information at an early stage of a proposed operation. A comprehensive report on sub-surface conditions, prepared by a nationally recognized concern, may determine the practicability or impracticability of a proposed bridge or tunnel location—a point which is of inestimable value both from an engineering and an economic viewpoint.

## UNDERPINNING

The usual object of underpinning is to permit carrying the foundation of a building below that of adjoining buildings. Underpinning may be required, also, because of changes in soil conditions due to the digging of subways, construction of deep sewers, lowering of water levels, etc. Such conditions often entail considerable trouble and expense. Competently handled, underpinning can be installed without serious disturbance of adjacent property. This type of service is described in greater detail on later pages.

## TEST BORINGS

### Soil Tests and Investigation

The Gow Division of the Raymond Concrete Pile Company supplies necessary information regarding soil conditions on a proposed site by two methods: (1) Driving a specially designed spoon into the earth through a guide casing and reclaiming characteristic samples in **as nearly the actual existing state as possible.** (2) Boring through boulders, hardpan, etc. (where it is necessary), recovering cored samples of the ledge.

A complete log is kept of the soils encountered, their geological classifications and other pertinent information, such as water levels. This log is submitted, together with boring samples, when the report is furnished.

### Laboratory Analysis

The Gow Division has developed equipment and methods for obtaining large "undisturbed soil samples" (from 3 to 5 inches in diameter) for laboratory analysis to determine bearing values of soils in the areas to be loaded. By this method, probable settlements corresponding to the loads proposed can be definitely established.

# FOUNDATIONS & ENGINEERING SERVICES

## INTERPRETING BORINGS AND TESTS

### The Value of Experience

From more than thirty-six years of pile driving, under the greatest variety of soil conditions and locations all over the country, the Raymond Company has acquired information, permanent records and test data relating to nearly every section. Tests conducted and interpreted with this background of wide experience are of unquestioned value to prospective builders. The amount of preliminary information in our files alone will prove materially helpful to anyone confronted with a foundation problem.

## DETERMINING ALLOWABLE LOADS

The allowable load per pile is naturally one of the first matters to be considered in a pile foundation. No hard and fast rules can be laid down and followed. The character and general purposes of the structure, the nature of the soil to be penetrated, and the bearing strata reached, as well as the size, shape, length, and type of the pile under consideration, are determining factors. The most generally accepted unit loading for concrete piles is 30 tons per pile. Under certain conditions, unit loads may have to be reduced, while under others, greater loads may be carried safely. Long experience with every sort of condition is of greater value than theory in determining the allowable load per pile.

## CARRYING CAPACITIES OF CONCRETE PILES

The carrying capacity of concrete piles under given conditions need not, and should not, be a matter of guesswork. Carrying capacity can be safely determined, provided always that correct methods of construction are followed. Well known formulae may be considered as a general guide but must be interpreted in the light of broad experience. The formula generally used is that known as the "Engineering News Formula," based upon the use of a single-acting steam hammer, as follows:

$$L = \frac{2WH}{S + 0.1}$$

L = Safe load in pounds.
W = Weight of falling parts in pounds.
H = Drop in feet of falling parts.
S = Final penetration per blow in inches.
In a No. 1 steam hammer, W = 5,000 and H = 3
In a No. 2 steam hammer, W = 3,000 and H = $2\frac{1}{2}$

Ordinarily, Raymond piles are driven to four blows to the last inch with a No. 1 steam hammer, for a working load of 30 tons per pile, thus adding 43% to the safety factor of the formula.

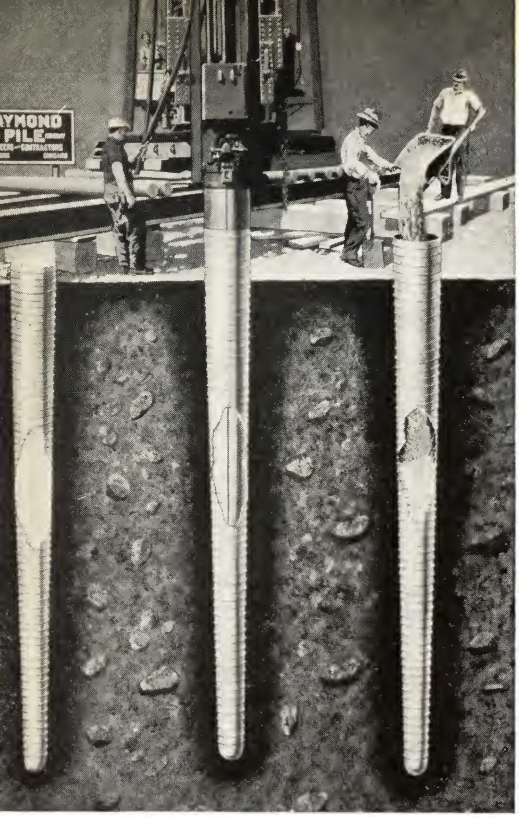
### Test Piles

If the soil in which the pile has its bearing is reasonably uniform or well known, and the underlying soil is free from vegetable matter, and **if the method followed is such that it can be known that no injury is suffered in driving,** it is usually a waste of money to make load tests. Experience has shown that driving to a uniform resistance will serve all practical purposes.

## OBTAINING FOUNDATION ENGINEERING SERVICE

The organization making tests such as those described should have three qualifications. First—long and broad experience; Second—a reputation for integrity; and Third—an absolutely unbiased attitude regarding the condition under consideration. The Raymond Concrete Pile Company has made tests of every description, and has installed foundations of every kind in every section of this country, and in many foreign countries. Raymond representatives are competent to advise with architects, engineers, and owners, and to offer suggestions free from bias. While the Company is interested in the installation of various types of concrete piles, caissons, and poured foundations, it will always endeavor to recommend the proper type of foundation.

**CITY HALL, Atlanta, Georgia**
**G. Lloyd Preacher & Co., Architects**
**Supported on**
**290 RAYMOND CONCRETE PILES**



Cut-away views of RAYMOND TAPERED CONCRETE Piles at successive stages of installation—CENTER, pile driven to grade—RIGHT concrete being poured—LEFT, ready for inspection.

# RAYMOND

## STANDARD TAPERED CONCRETE PILES

From the standpoint of general use and acceptance, the tapered type of pile has led all others in the concrete pile field for the past thirty-six years. Its successful experience, its record of usefulness, and its sterling performance have been dominant factors in the development of the concrete pile industry in the United States and in many places abroad.

The value of the taper has been proved in literally thousands of structures of infinite variety, ranging from small dwellings to mammouth industrial buildings and towering skyscrapers. Structures resting on Raymond Tapered Concrete Piles dot the United States, are found in the Philippines, China and Sumatra, and from Newfoundland to the Argentine Republic.

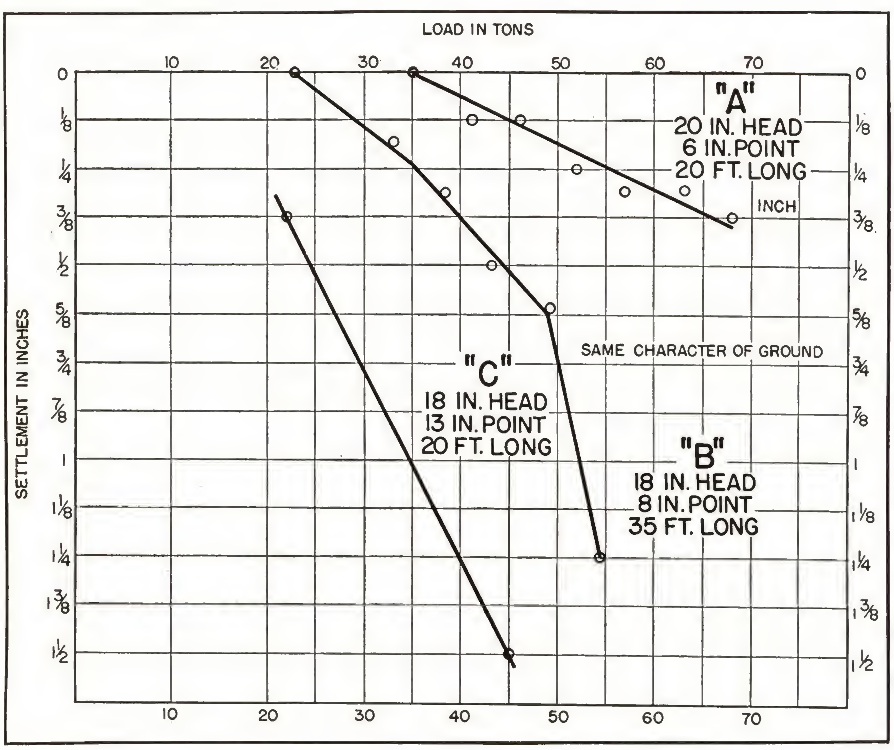
## THE RECOGNIZED VIRTUES OF THE TAPER

1. The maximum of bearing value is developed in every square inch of soil in contact throughout the pile's entire length.

2. Due to the tapering wedge shape, the **pile cannot settle the smallest fraction of an inch without forcing lateral movement** of every square inch of soil in contact with its surface.

3. It follows that, except for point bearing conditions, **Raymond Concrete Tapered Piles assure the desired load carrying capacity with shorter lengths** than would be required if parallel-sided piles were used—or conversely, should tapered and parallel-sided piles be driven to the same length, **the tapered pile will carry the greater load** (see chart below), and if driven for the same load the tapered pile would be shorter.

## COMPARATIVE BEARING TEST RESULTS




The following test was made under the supervision of a prominent engineer—Two piles, each twenty feet long, were driven within a few feet of each other. "Pile A," was 6 inches in diameter at the point and 20 inches in diameter at the top, "Pile C," was 13 inches in diameter at the point and 18 inches in diameter at the top. "Pile C" drove fairly hard from the start, and required 944 blows of the steam hammer to secure a penetration of twenty feet. "Pile A," with the smaller point, started easily and required only 875 blows to secure twenty feet of penetration.

At the expiration of a month, both piles were loaded and carefully tested. "Pile A," the pile with the greater taper, carried a proportionately greater load, showing no appreciable settlement up to sixty-five tons; whereas "Pile C," the less tapered pile, showed the same settlement with a load slightly more than twenty tons. The result is particularly interesting in view of the fact that the engineer who made the tests did so for the specific purpose of showing that a pile of large surface area had greater carrying capacity than a pile which, even though smaller, was more heavily tapered. The results of these tests have been confirmed many times in the course of our experience.

# *Standard Tapered* CONCRETE PILES

## COMPARATIVE COST OF TAPERED VS. NON-TAPERED PILES

The failure to appreciate the greater carrying capacity of the Raymond Tapered Pile has unexpectedly increased the cost of many concrete pile foundations, contracts for which were awarded solely on the basis of the **lowest price per lineal foot,** without consideration of the probable length to which each type might be driven.

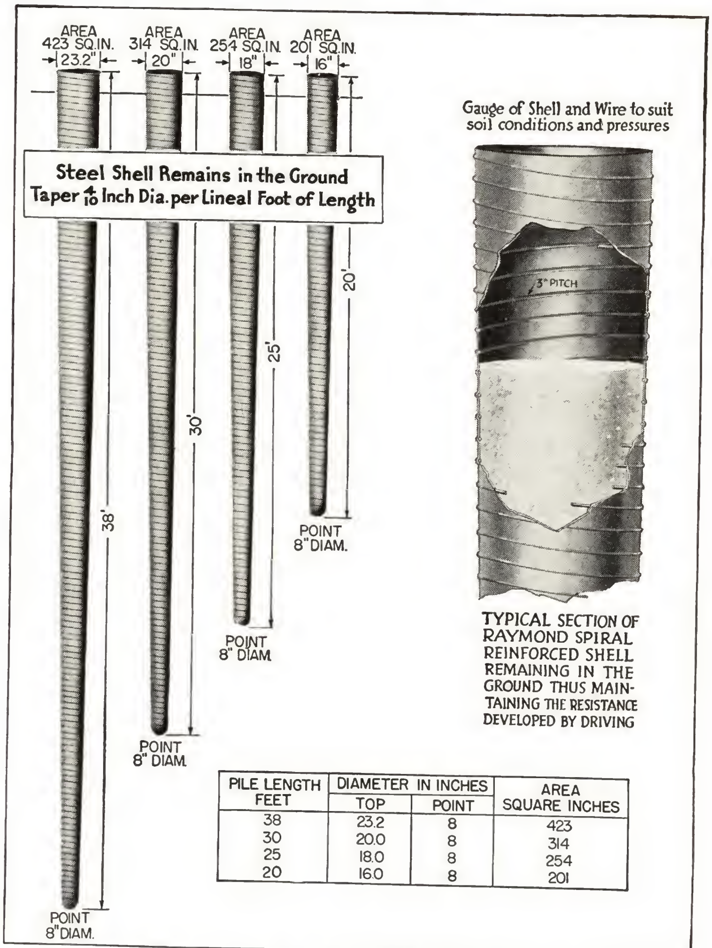
It is, therefore, obvious that the bidder who bases his price per foot on the use of a pile of uniform diameter throughout its length may realize that, unless the site overlies hardpan or rock, he will obtain a very much greater average length of pile than will his competitor who bids on a tapered pile.

## OBSERVATION OF PENETRATION DURING DRIVING

Since in placing a Raymond pile the weights of the driving core and hammer are constant, and since the method of installation is such that one pile must be like another, it is possible to determine the safe load each pile can be relied upon to support. This is done by observing the penetration under each blow of the hammer, and by noting the final resistance as measured in terms of average penetration per blow for the last inch.

## OVERCOMING ANY DEFECTS

Should it appear, upon inspection, that a shell has been torn in driving, or should unsuspected pressures develop at some point, resulting in the entrance of water or other foreign substance, the defect can be immediately remedied by the insertion of another shell, driving it to resistance before the concrete is poured. Any distortion that may occur in a pile made without a form, or with a temporary form—any fracture that may occur in the driving of a precast pile—must of necessity remain hidden. Subsequent settlement may call attention to the existence, though not to the extent nor the nature, of the concealed fault.




| PILE LENGTH FEET | DIAMETER IN INCHES TOP | POINT | AREA SQUARE INCHES |
|---|---|---|---|
| 38 | 23.2 | 8 | 423 |
| 30 | 20.0 | 8 | 314 |
| 25 | 18.0 | 8 | 254 |
| 20 | 16.0 | 8 | 201 |

**Above: Sectional view of shell and relative cross sectional areas of Raymond Tapered Piles.**

## CONSTANT INSPECTION

Attention is directed to illustrations showing the construction of the "left-in place" shell made of steel of the proper gauge, and spirally reinforced to the degree which examination of each pile, after driving, shows to be adequate. This means inspection after every operation is completed, except the pouring of the concrete. Thus the hazards of distortion and loss of resistance are eliminated.

**Below: A large group of RAYMOND STANDARD TAPERED CONCRETE Piles complete and ready for footings—Note spacing, alignment and uniform grades.**

RAYMOND STEP-TAPERED Pile partially driven.

## CLASSIFICATION OF INDUSTRIAL USES OF THE RAYMOND STEP-TAPERED PILE

The Raymond Step-Tapered Pile has received universal acceptance in the engineering and construction world. The clientele making use of this type of pile to meet its special requirements classifies roughly as follows:

| Contract | Projects | Piles | Lineal Feet |
|---|---|---|---|
| U. S. Government Projects | 20 | 27,700 | 830,000 |
| Oil Companies | 8 | 7,100 | 262,000 |
| States, Counties and Municipalities | 58 | 23,100 | 915,000 |
| Railroads, Viaducts, Grade Separations, etc. | 9 | 2,600 | 90,000 |
| Automobile Plants | 9 | 8,200 | 439,000 |
| Steel Plants | 7 | 15,600 | 800,000 |
| Miscellaneous Industrial Structures | 44 | 13,100 | 431,000 |
| Miscellaneous Structures, such as Office Buildings, Schools, Churches, etc. | 30 | 9,800 | 707,000 |

# RAYMOND

## *For Pile Construction up to 100 Ft. and Over*

Early in 1931, the Raymond Concrete Pile Company developed the Raymond Step-Tapered Concrete Pile, embodying the fundamentals of the original Raymond Standard Tapered Pile, but permitting of increased lengths up to 100 ft. and over.

Raymond Step-Tapered Piles provide an efficient and economical foundation solution where: (1) soil is of doubtful supporting value to a depth of 30 ft. or more, but is underlain by rock, hardpan or gravel into which the pile points may be driven, (2) hard soil, difficult to penetrate though unreliable because of yielding strata between it and sound footing, which must be penetrated by the piles, (3) alternate strata of hard and soft material which must be penetrated to reach firm bearing.

## RANGE OF GEOGRAPHIC ADAPTATION

Projects employing Raymond Step-Tapered Piles have been located in various states from coast to coast, and from Canada to the Gulf. They have included the placing, through fill and silt, rock, clay, sand and shifting soil; of as many as 12,000 piles in a single project and as few as 8, ranging in length from 16 to 100 feet or more.

## CONSTRUCTION

The shell is in sections, spirally corrugated to provide increased resistance to external pressures. The "steps" result from successive diameter increases from the point upward—usually 1" in eight feet. To the bottom of each section is welded a double flange plow ring, to the lower flange of which is welded a short spirally corrugated inner sleeve, so that each section is screw-connected to the section below. A heavy gauge hemispherical steel boot, welded to the lowest plow ring, forms the point of the shell.

# *Step Tapered* CONCRETE PILES

The gauges of metal used generally vary from 20 to 14 but are, in some instances, as heavy as #10 or as light as #24, depending on the nature of the soil to be penetrated, and the pressures to be retained. Lighter sections are used nearer the surface of the ground. All seams of the shell sections are electrically welded and watertight.

The heavy walled, hollow core has a "stepped" outer surface to correspond to the steps of the shell. These "steps" which are beveled, bear directly on the beveled inner surfaces of the plow-rings of each shell section.

Various lengths and sizes of cores are built to fit the requirements of particular jobs and for specific conditions

**RAYMOND STEP-TAPERED Shell Screw-Ends showing plow ring and screw collars for joining into full length shell unit.**

## INSTALLATION UNDER SEVERE DRIVING CONDITIONS

On several jobs where the Raymond Step-Tapered Pile has been used, driving conditions have been so severe that it has been necessary to continue the driving to a degree of hammer resistance heretofore unknown. For instance, on one pile we have a record of driving with a 5000 lb. hammer falling 3 ft. and operating sixty blows to the minute for a period of 63 minutes and, in another instance, a total on one pile of more than 5200 blows with a No. 1 hammer to secure a penetration of about 31 ft. in order to reach rock. In both instances, upon withdrawal of the driving core, the shell was found to be undamaged and a perfect form for the concrete.

**Below: Stock Pile of RAYMOND STEP-TAPERED Shells nested as shipped.**

## DIMENSION DATA

The usual dimensions of Raymond Step-Tapered Piles are as follows:

| Length | Top Diameter | Point Diameter |
|---|---|---|
| *16 feet | $11\frac{7}{8}$ inches | $10\frac{5}{8}$ inches |
| *24 feet | $12\frac{7}{8}$ inches | $10\frac{5}{8}$ inches |
| *32 feet | $13\frac{7}{8}$ inches | $10\frac{5}{8}$ inches |
| 40 feet | $14\frac{7}{8}$ inches | $10\frac{5}{8}$ inches |
| 48 feet | $15\frac{7}{8}$ inches | $10\frac{5}{8}$ inches |
| 56 feet | $15\frac{7}{8}$ inches | $9\frac{3}{4}$ inches |
| 64 feet | $15\frac{7}{8}$ inches | $8\frac{7}{8}$ inches |
| 72 feet | 17 inches | $8\frac{7}{8}$ inches |
| 80 feet | 17 inches | $8\frac{7}{8}$ inches |
| 88 feet | 17 inches | $8\frac{7}{8}$ inches |

*When for any reason a greater cross-section appears to be desirable, it is possible to accomplish this by removing the lower sections of the core and using two or more of the upper sections with driving points of corresponding size adapted thereto, thus:

A pile 32 ft. in length might have a top diameter of $15\frac{7}{8}$ in. and a point diameter of $12\frac{7}{8}$ in., or

A pile 24 ft. in length might have a top diameter of $15\frac{7}{8}$ in. and a point diameter of $13\frac{7}{8}$ in., or

Other combinations may be used to suit the requirements of a particular situation, such as the use under certain conditions of a 10 or 12 in. diameter pipe or other steel member extending below the regular shell, and permitting the pile to reach bearing in extraordinarily deep strata. Details of these combinations will be supplied in each instance as occasion may call for them.

2/2

# CONCRETE PILE ADVANTAGES

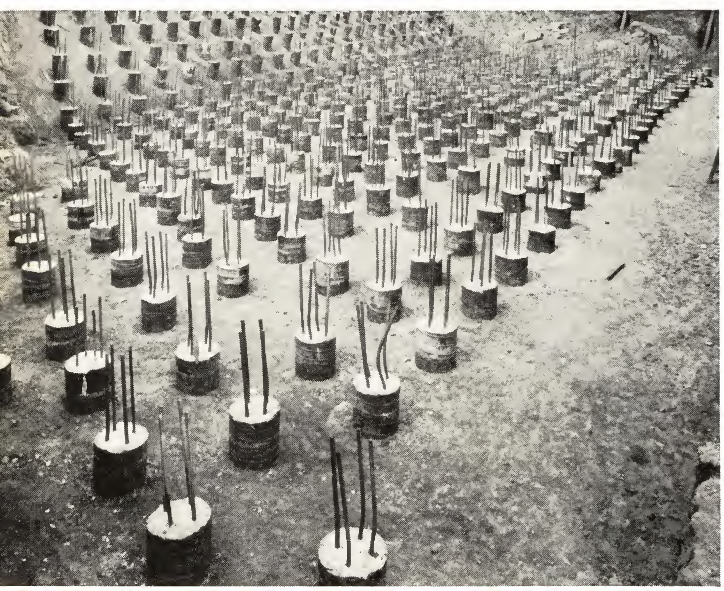
## ABSOLUTE PERMANENCY

Concrete piles, not being subject to decay or attacks of wood borers and other destroying agents are, naturally, far more permanent than wood piles.

This permanency of concrete piles, regardless of moisture conditions, naturally eliminates the excavation, sheeting, shoring and pumping necessary, in the case of wood piles, to reach a cut-off below permanent water level. The concrete pile heads can be left at an elevation only sufficiently below the floor line to permit of the proper distribution of loads.

**RAYMOND TAPERED CONCRETE Piles in abutment of Glendale-Hyperion Viaduct over Los Angeles River—Note five rows of battered piles in background.**

**Below: A six-pile pier of RAYMOND STEP TAPERED CONCRETE Piles.**



## GREATER CARRYING CAPACITY

The greater carrying capacity of concrete piles arises from several factors such as (a) They have greater size, therefore greater displacement. (b) Perfect shape—of uniform size and straightness—thus insuring full ground contact and centering of the load over the point of the pile. (c) Possibility (with the Raymond type of pile) of inspection after driving, hence the ability to load to greater capacity, instead of making allowances for inefficiency as in the case of wood piles, which are subject to injury by overdriving, telescoping, departing from the vertical and like defects, **none of which are discernible after driving begins.**

## CENTERING OF COLUMNS

All designers appreciate the advantage of keeping their column centers as near as possible to the center of gravity of the pile groups, thus reducing, and in many cases avoiding, expensive cantilevers. This is no small consideration when wide footings and limited property lines result in eccentric loads which cannot be otherwise provided for.

## SAVING IN TIME

The principal reasons for the time saving accomplished by the use of concrete piles are, (a) The smaller number of piles required. (b) The reduction in quantities of excavation, shoring, sheeting and pumping. (c) The reduction in quantities of footings or masonry. (d) The manufacture of the piles in place, from materials readily procurable in all localities, and (with the Raymond type of pile) limiting of manufacture to the actual number and length of piles required. This obviates delay for cutting and trimming trees, hauling to shipping point, transporting for great distances by rail or water and delivery to the job, perhaps only to find that the piles are too long or too short.

It is frequently the case that a concrete pile foundation can be completely installed in less time than would be required for the necessary materials for a wood pile foundation to be delivered to the site.

The Raymond Concrete Pile Company, with its organization and equipment so widely distributed over the United States, is in a particularly favorable position to give prompt service and has a reputation for completing its contracts on time.

## WOOD PILING AND SHIFTING WATER LEVELS

Many authorities agree that wood piling would be of permanent value (unless exposed to the attacks of subaqueous "borers" or other simliar deletorious conditions), **if constantly saturated or submerged.** The problem of **maintaining saturation,** however, is becoming more and more difficult. Changes in water level, once a problem only where tides or currents had to be considered, now confronts the architect in the midst of large cities where subways, sewers and other structures affecting underground water level are constantly being constructed. It can no longer be assumed that piles whose tops are well under water when the foundation is built will still be beneath water level a few years later.

Examples of some of the effects on wood piling produced by this cause are illustrated on this page.

**Above: Old wood piles in Pier No. 6 and No. 7, Central Harlem Health Center, New York City. Water level 2 feet below water shown in picture. Note condition of all wood piles.**

## CONCRETE PILE CLASSIFICATIONS

Broadly speaking, concrete piles are of two distinct types:

(1) Piles which are poured or cast in forms previously driven in the ground, referred to as "cast-in-place" piles.

(2) Piles which are cast in forms, above ground, then driven like wooden piles—referred to as "pre-cast" piles.

The Raymond Pile is the outstanding example of the type involving the use of an economical permanent form which is **driven in contact with the soil and left in the ground to preserve driving compression** and the integrity of the finished pile. This **driven, permanent** steel shell is essential to dependable results for these reasons:

(1) It serves as a form for the concrete.

(2) It prevents the admixture of foreign substances with the concrete, and protects it from excess of ground water during the cement setting period.

(3) It retains the original moisture in the concrete until it is thoroughly hardened.

(4) It prevents distortion by external pressure, due to the driving of adjacent piles or accumulated pressures from displacements by the pile itself.

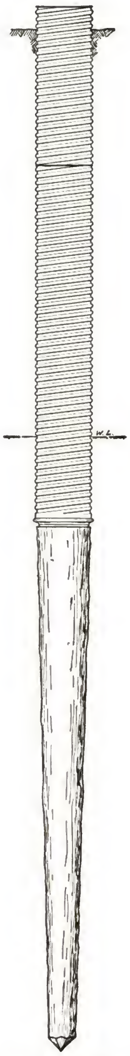
(5) It retains perfectly the displaced earth forming the walls of the cavity, so that there may be no relaxation of the ground and, therefore, no loss of the original driving compression.

(6) It acts as reinforcement of the pile until the concrete shall have attained its maximum strength.

It is only necessary to point out these functions of the "shell" to demonstrate that, in the "cast-in-place" type, where no shell is used or where the concrete is placed loosely in the ground, vital safeguards are omitted as a result of false economy. All the points raised as to the necessity of the shell apply with equal force as **arguments against its omission.**

**Left: Rotting Wooden Piles on Site of Cattle Pen Building, Pennsylvania Railroad, Philadelphia, Pa.**

# COMPOSITE AND PRE-CAST PILES



Composite Pile Assembled.

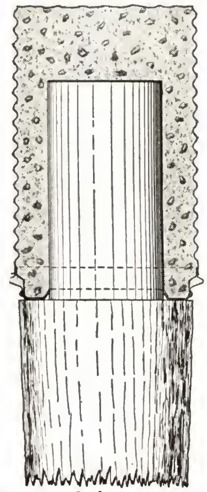
## ADVANTAGES OF THE COMPOSITE PILE

As previously explained in this catalog, wood piles can be successfully used **where there is assurance of permanency of saturation.** Where deep piling is indicated and the ground water level is shifting in nature, the composite pile (an early development of the Raymond Concrete Pile Company), has been found to efficiently and economically provide the solution.

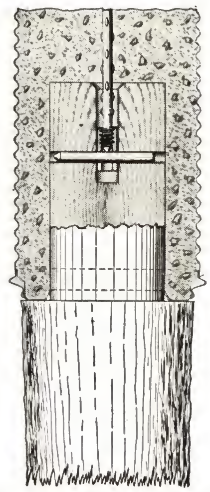
This type of pile, as its designation implies, comprises a cast-in-place concrete pile superimposed upon a wood pile. The respective lengths of the concrete and wood sections depend on the elevation of permanent water level in relation to the ground surface, and the depth at which firm bearing may be reached. In general, the load is carried by the wood pile, the concrete section acting as a column through that portion of the soil not continuously saturated. The concrete section may be either cast-in-place or pre-cast, straight-sided or tapered.

## CAST-IN-PLACE UPPER SECTIONS

Pre-cast upper sections are seldom economical and seldom used because lengths must be predetermined. The cast-in-place upper section is therefore preferable, since its length can be varied as required. Should the wood pile section fail to reach firm bearing at the expected length, the concrete section, if cast-in-place, may be correspondingly increased in length.



**The usual form of joint between the cast-in-place concrete upper section and the wood section of a composite pile as applied by the Raymond Concrete Pile Company.**



**The same joint with added advantage of lock-pin and bar — Observe bite of shell sealing ring into wood tenon.**

## PRE-CAST PILES

Pre-Cast Piles, although infrequently used for building foundation work, have a large and useful field in the construction of docks, bulkheads and other marine structures.

As Pre-Cast Piles are manufactured before being driven, it is necessary to determine the length of pile required a considerable length of time in advance of driving. As this can seldom be accurately done, some waste is involved in length allowances and subsequent cutting off of over-long piles.

**Above: Wood sections of composite piles with machine cut tenons.**

**Left: Shell enveloped core being lowered over driven wood section for final driving.**

# GENERAL CONCRETE PILE SPECIFICATIONS

The following specifications for cast-in-place piles and an alternative specification for precast piles conform with the general requirements of all the principal cities in the United States, for piles up to 60 ft. in length. For piles in excess of 60 ft. in length, these specifications should be modified slightly. The Raymond Concrete Pile Company's representative will be glad to discuss these modifications in detail.

## CONCRETE PILES:

Where indicated on the drawings, furnish and place the required number of concrete piles as specified, to support the foundations. Excavation shall be made to the pile cut-off before any piles are driven. Concrete piles shall be either cast-in-place or precast piles.

## CAST-IN-PLACE PILES:

Cast-in-place piles shall have steel shells driven to the required bearing, the shells being left permanently in place and filled with concrete. All shells shall be of sufficient strength and rigidity to permit of their driving, and to prevent distortion caused by soil pressures or the driving of adjacent piles. The shells shall also be sufficiently water-tight to exclude water during the placing of the concrete.

Piles shall be cylindrical or tapered. If tapered, they may be either of a constant increase in diameter or uniformly stepped. The minimum diameter of cylindrical piles shall be 14", and the minimum diameter of tapered piles shall be 8" at the point and 14" at the head. The average diameter shall be not less than 11".

Concrete shall be composed of one part approved Portland cement to three parts clean, sharp sand, and five parts of gravel or crushed stone of suitable quality, thoroughly mixed and properly proportioned as to water content. All coarse aggregate to pass a 3/4" ring.

The use of piles in which fresh or unset concrete is placed against the soil will not be permitted.

## PRECAST PILES

Precast piles shall be of uniform cross-section or tapered, and shall have at least an average cross-section area of 196 square inches up to 20' in length and 225 square inches if in excess of 20'. They shall be reinforced with longitudinal reinforcing steel not less than 2% of the average gross cross sectional area of the pile and any additional reinforcing steel necessary to take care of the stresses due to handling or driving. Lateral reinforcing shall consist of 1/4" diameter hoops spaced 12" on center for the full length of the pile, excepting for 3' at the head and point where the hooping shall be not over 3" on center. There shall be at least 2" of concrete protection outside the reinforcing steel.

Forms shall be tight and rigid to prevent leakage or distortion. All piles shall be plainly marked with the casting date and shall be cured for a period of 30 days and shall not be handled or removed from the casting platform prior to this time without the approval of the Engineer. Piles must be cured at an even temperature in order that they may get a proper set; therefore, in warm weather they should be kept moist for a time, while in cold weather they shall be heated until they have properly set and cured. If cast in tiers, the lower piles shall be at least 14 days old before any superimposed load is placed upon them.

If precast piles are used, the Contractor shall drive enough test piles to predetermine the length of pile required to secure the specified bearing and required penetrations in the various areas of the work. These tests shall be made sufficiently in advance of the pile driving to prevent delay in the progress of the work, and to enable the Contractor to have on hand at all times, piles of proper length to meet any condition that may arise.

Concrete shall be composed of one part approved Portland cement to two parts of clean, sharp sand and four parts clean gravel or crushed stone, thoroughly mixed and properly proportioned as to water content.

## DRIVING:

All piles shall be driven to a resistance satisfactory to the Engineer, by such methods as will not impair their strength and as will insure the retention of that resistance.

Jetting shall only be done when permitted by the Engineer. When piles are jetted, they shall be driven to the required resistance after jetting has ceased.

The driving of all piles shall be continuous, without intermission, until the pile has been driven to its final resistance.

All cushions must be approved by the Engineer. No free swinging leads will be permitted, and the equipment shall provide adequate support to firmly hold the pile in correct position while being driven.

The pile shall be driven to a sufficient depth to carry the imposed loads, and the Engineering News formula shall be considered to indicate the load that can be safely supported by a pile. The pile driving hammer shall develop an energy per blow of at least 12,000 foot pounds.

## PAYMENT:

All piles shall be measured from the point to the cut-off elevation shown on the plans. No payment will be made for withdrawn, broken or rejected piles, nor for portions of piles remaining above the cut-off.

The following is a suggested specification for use when conditions indicate the desirability of composite piles.

## COMPOSITE PILES:

Composite piles shall consist of a concrete section from the bottom of the footing to 1' below water level, superimposed upon a wood pile of suitable size and length. The concrete portion of the pile shall be of such cross-section that the load placed upon it shall not exceed 350 lbs. per square inch of area. The wood pile shall have a minimum diameter of not less than 13" two feet from the head and a minimum diameter of 6" at the point, except that where piles exceed 60' in length point diameters may be not less than 5".

### Wood Pile Section:

All piles shall be sound and free from sharp crooks or bends and sufficiently straight so that a line drawn from the center of the head to the center of the point will lie wholly within the pile. The joint between the concrete and wood sections shall be so constructed as to exclude water or other foreign materials and shall be of sufficient strength so as to provide against an uplift of 10 tons without separation.

### Concrete Pile Section:

Concrete shall consist of one part approved Portland cement, two parts clean, sharp sand, and four parts clean gravel or crushed stone, thoroughly mixed and properly proportioned as to water content; all coarse aggregate to pass a 3/4" ring. In no case shall fresh or unset concrete be placed in contact with the surrounding soil.

# 2 UNDERPINNING AND CAISSONS

Necessity for underpinning is generally incidental to: (a) The protection of structures from settlement damage due to nearby operations, such as adjacent basement, sewer, or other excavations being carried to or below the elevation of the original footing. (b) Correcting original foundation errors where settlement has developed due to compression of the soil. (c) Reinforcement of the foundation to provide for additional stories or increased loadings, sometimes because of changes in the uses of the building itself.

The type of underpinning most suitable depends upon the character of the original foundation, the design of the substructure, and the conditions under which the underpinning must be carried on with the least disturbance to current normal operations. Under certain conditions, sectional piles jacked down to suitable bearing, using the original walls and footings for reaction, are the most practical and economical. In other cases, caissons are preferable. Under still other circumstances, it is desirable to carry the original footings deeper to a better subsoil bearing.

## GOW CAISSON PILES

Caissons of this type are installed by the Gow Division of the Raymond Company, and, when ground conditions are suitable, are probably the least expensive type.

Excavation is done by hand inside of steel cylinders. A shallow starting pit is excavated first and the top cylinder is driven down in this pit; soil inside this cylinder is then excavated. A second cylinder, about 2 in. smaller in diameter, is placed inside the first one and driven down and the entire process is repeated until caisson reaches its full depth. The lowest cylinder is driven into the final bearing stratum to seal off.

The lower section is then filled with concrete and the lower **cylinder** withdrawn. The next cylinder is then filled and withdrawn, etc., until all are withdrawn, leaving the completed caisson in place (usually belled out from shaft diameter at the bottom), and increasing in diameter by 2 in. steps in each eight feet up to the elevation of the footing.

When machine excavation is practicable, a substantial saving in time can be effected with consequent economy.

The economy of this type of caisson is due to re-use, and salvage, of the cylinders which only temporarily line the excavation, and also to the lack of heavy equipment and overhead requirements.

## PNEUMATIC TYPE

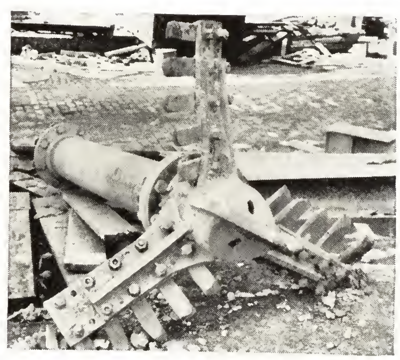
Operations are carried on in this type under air pressures up to 48 lbs. per square inch, which requires air locks for entry and removal of workmen and materials and other costly and heavy equipment. This process makes for relatively slow progress and is seldom employed where any other method is possible.

## WET PROCESS CAISSON

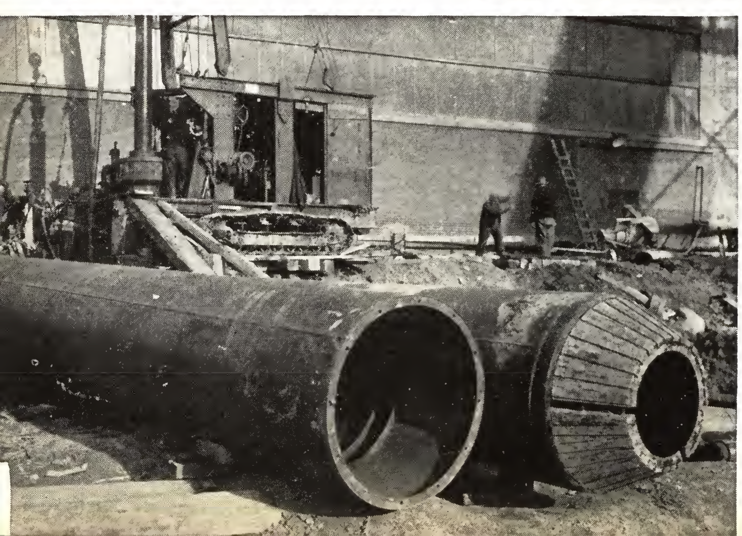
Wet Process Caissons are installed by a "spud drilling" process employing a specially designed spider-like drill member with radiating arms adjusted to the exact diameter of the caisson. This drill is rotated from the top and water usually mud laden under heavy pressure forced through its hollow stem, emerging at the point to assist in the cutting action. A portion of the material drilled rises to the top under the continuing pressure and over-flows into an adjacent sump.

When the final bearing strata has been reached, the spud drill is removed, and a steel cylinder lowered into the hole and driven to final seal. The fluid and residue remaining is then pumped out, the bottom cleaned and inspected, and the concrete poured in the ordinary manner. (In some instances the cylinder is withdrawn as soon as concrete is poured and is re-used.)

**Right: SPUD DRILL used in WET PROCESS TYPE CAISSON** — Note apertures for water emergence at point and attached section of drill pipe— also cutting teeth attached to drill arms.



**Below:**
**Cylinder Sections used in WET PROCESS TYPE CAISSON.**



**Below: Installation of GOW CAISSON PILES—Note 3 steel cylinders partially exposed in foreground.**

# SPECIAL CONCRETE WORK

## SHORE PROTECTION • JETTIES BRIDGES • RETAINING WALLS HYDRO-ELECTRIC PLANTS • DAMS RIVER IMPROVEMENTS • PIERS TUNNELS • TRESTLES

The illustrations appearing on this page serve to show partially the character of the Raymond Company's activities in other fields than foundation work. In many of these projects the Company's connection has been continuous from the stages of preliminary survey and reports, through the processes of planning and design, on to complete construction, and, in some instances, operation subsequent to completion.

Each project has produced its own problems, and each has required its special treatment. Each successive accomplishment has added to the experience and knowledge of the organization, and increased its ability to further serve the architectural and engineering professions.

**Above: Section during construction of five mile reinforced concrete sea wall on Lake Pontchartrain (La.). Supported on reinforced concrete bearing and batter piles and a cut-off wall of tongue and groove reinforced Raymond Concrete Sheet Piles.**

**Right: Sections of 34 in. diameter Reinforced Concrete Pipe used for 45,500 ft. supply line.**

**Left: One of a large number of oil well derrick bases for Lago Petroleum Company in Lake Maracaibo, Venezuela.**

**Right: Complete Harbor Development at Puerto Cabello, Venezuela —for Venezuelan Government.**

**Below: Boca Ciega Causeway near St. Petersburg, Florida—length 2800 ft., width 30 ft. This was one of three similar structures built by the Raymond Company under the same contract.**

**Below: Retaining the waters of Lake Maracaibo, Venezuela, S. A.—Reinforced concrete sheet pile watertight dyke, 2.73 miles long.**

# RAYMOND
## CONCRETE PILES